We claim:

1. A process of making a device for conducting unit operations on a fluid comprising:

stacking a plurality of shims such that a continuous flow path is formed through the shims;

wherein the flow path extends in a direction substantially parallel to shim thickness;

wherein the plurality of shims comprises at least three adjacent shims through which a flow path is formed and wherein a straight, unobstructed line is present through the flow path in said at least three shims;

wherein the three shims are configured such that a unit operation can be performed on a fluid in the flow path; and

bonding the shims to form a device capable of performing a unit operation on a fluid.

2. The process of claim 1 wherein the each of the at least three adjacent shims comprise at least one aperture selected from the group consisting of: circles, triangles, waves, ovals, irregular shapes and rectangles or squares or triangles with rounded corners.

3. The process of claim 2 wherein the each of the at least three adjacent shims comprise at least one aperture selected from the group consisting of: circles and triangles; and

wherein the at least three shims are bonded to form a device comprising a channel having a cylindrical or prismatic shape.

4. The process of claim 1 wherein each of the at least 3 adjacent shims is identical.

5. The method of claim 1 further comprising the step of placing a catalyst or sorbent in said flow path.

6. The method of claim 1 wherein the flow path in said at least three shims does not mix with any other flow paths.

7. The method of claim 1 further comprising the step of placing a static mixer in said flow path.

8. A device formed by the method of claim 1.

9. A process of conducting a unit operation comprising the step of passing a fluid through the device of claim 8.

10. A process of making a device from a plurality of shims, passing a fluid through said device and conducting a unit operation on the fluid, comprising:

stacking a plurality of shims such that a continuous flow path is formed through the shims;

wherein the flow path is substantially parallel to shim thickness;

wherein the plurality of shims comprises at least three shims through which a flow path is formed and wherein a straight, unobstructed line is present through the flow path in said at least three shims;

wherein the flow path in said at least three shims does not mix with any other flow paths;

bonding the shims to form a device capable of performing a unit operation on a fluid;

passing a fluid into the device such that a fluid passes through the flow path in said at least three shims; and

performing at least one unit operation on the fluid as it passes through the flow path in said at least three shims.

11. The process of claim 10 wherein the flow path formed in said at least 3 shims is defined by the borders of apertures in said at least 3 shims, and wherein, in each of said at least 3 shims there is a border defining a flow path, the border having a circumference and wherein said circumference in each shim is at least 20% populated by edge features.

12. The process of claim 10 wherein the flow path formed in said at least 3 shims is defined by the borders of apertures in said at least 3 shims, and wherein, in at least one of said at least 3 shims there is a border defining a flow path, the border having a circumference and wherein said circumference in each shim is at least 20% populated by edge features, and wherein in another of said at least 3 shims there is a border defining a flow path, and the border is smooth.

13. A process of conducting a unit operation on a fluid, comprising:

stacking a plurality of shims such that a continuous flow path is formed through the shims;

wherein the flow path is substantially parallel to shim thickness;

wherein the plurality of shims comprises at least three shims through which a flow path is formed and straight, unobstructed line is present through the flow path in said at least three shims;

bonding the shims to form a device capable of performing a unit operation on a fluid;

passing a fluid into the device such that the fluid passes through the flow path in said at least three shims; and

performing at least one unit operation on the fluid as it passes through the flow path in said at least three shims.

14. The process of claim 13 wherein the device is capable of performing at least one unit operation selected from the group consisting of: vaporization, compression, chemical separation, distillation, reaction and condensation.

15. The process of claim 13 wherein the flow path in said at least three shims does not mix with any other flow paths.

16. The process of claim 13 wherein said fluid comprises at least a portion of a reaction composition; and

further comprising a second fluid that passes through a second flow path in said at least three shims.

17. The process of claim 16 wherein the fluid in said flow path and the second fluid in said second flow path do not mix.

18. The process of claim 17 wherein the fluid in said flow path and the second fluid in said second flow path in said at least three shims are separated by a distance of 5 mm or less and wherein the pressure in said flow path and the second flow path differ by at least 1 atm.

19. The process of claim 18 wherein the pressure in said flow path and the second flow path differ by at least 10 atm.

20. The process of claim 18 wherein the fluid in said flow path and the second fluid in said second flow path in said at least three shims are separated by a distance of 1 mm or less and wherein the pressure in said flow path and the second flow path differ by at least 19 atm.

21. The process of claim 17 wherein the fluid in the second flow path is a heat exchange fluid.

22. The process of claim 18 wherein the flow path comprises first supports that extend across the flow path, and the second flow path comprises second supports that extend across the second flow path; and

wherein the first supports and the second supports are staggered.

23. The process of claim 17 wherein the second fluid comprises a second reaction composition;

wherein the reaction composition reacts exothermically; and

wherein the second reaction composition reacts endothermically.

24. A process of conducting a unit operation on a fluid, comprising:

stacking a plurality of shims such that a continuous flow path is formed through the shims;

wherein the flow path is substantially parallel to shim thickness;

wherein the plurality of shims comprises at least three shims through which a flow path is formed and wherein the flow path in said at least three shims has a minimum dimension (height or width) of at least 10 μm;

bonding the shims to form a device capable of performing a unit operation on a fluid;

passing a fluid into the device such that the fluid passes through the flow path in said at least three shims; and

performing at least one unit operation on the fluid as it passes through the flow path in said at least three shims.

25. The process of claim 24 wherein the unit operation is selected from the group consisting of: chemical reaction, vaporization, compression, chemical separation, distillation, condensation, heating, and cooling.

26. The process of claim 24 wherein the flow path has a maximum dimension (height or width) of at most 5000 μm.

27. A process of making a device from a plurality of shims, passing a fluid through said device and conducting a unit operation on the fluid, comprising:

stacking a plurality of shims such that a continuous flow path is formed through the shims;

wherein the flow path is substantially parallel to shim thickness;

bonding the shims to form a device capable of performing a unit operation on a fluid;

wherein the unit operation is selected from the group consisting of distilling, reacting, adsorbing, heating, cooling, compressing, expanding, separating, absorbing, vaporizing, condensing, and combinations of these;

passing a fluid into the device such that the fluid passes through the flow path in said at least three shims; and

performing at least one unit operation on the fluid as it passes through the flow path in said at least three shims.

28. The process of claim 27 wherein the plurality of shims comprises at least three shims through which a flow path is formed and wherein a straight line can be drawn through the flow path in said at least three shims.

29. The process of claim 28 wherein the device is capable of at least two different unit operations.

30. The process of 29 wherein there is a second flow path adjacent to said flow path and wherein a heat transfer fluid flows through said second flow path.

31. The process of claim 29 wherein the at least two different unit operations comprise heat transfer and chemical reaction, and further wherein there combustion is occurring in said flow path and a steam reforming reaction is occurring in the second flow path.

32. A method of making a laminated device containing a component, comprising:

stacking at least four shims;

wherein each of said at least four shims comprises an aperture;

wherein the apertures in each of said at least four shims form a continuous flow path through each of said at least four shims;

wherein the aperture in each of said at least four shims is empty or is partially blocked by a mixing projection;

wherein a straight, unobstructed line is present through the continuous flow path or through the continuous flow path and mixing projections; and

bonding the at least four shims.

33. The method of claim 32 wherein the aperture in each of said at least four shims is empty and a static mixer is inserted into the aperture.

34. The method of claim 32 wherein the aperture in each of said at least four shims comprises a projection.

35. The method of claim 34 wherein the aperture comprises sides and wherein the projection extends from one side of the aperture to another side of the aperture.

36. The method of claim 33 wherein each of said at least four shims has an identical design.

37. A device formed by the method of claim 32.

38. A laminated device, comprising:

a first set of microchannels wherein each microchannel has an inlet and an outlet,

a header connected to the inlets of the first set of microchannels;

a footer connected to the outlets of the first set of microchannels; and

comprising a header or footer structure, wherein

the header has a surface that curves toward at least a portion of the inlets of the first set of microchannels, or

the footer has a surface that curves toward at least a portion of the outlets of the first set of microchannels, or

the footer comprises a roof, located on a side of the footer opposite the side that is connected to the outlets of the first set of microchannels, and the roof is sloped relative to the outlets of the first set of microchannels.

39. The device of claim 38 further comprising a second set of microchannels that are adjacent to and in thermal contact with the first set of microchannels.

40. The device of claim 39 wherein the device comprises a condensor or a vaporizer.

41. The device of claim 38 wherein

the header has a surface that curves toward at least a portion of the inlets of the first set of microchannels, or

the footer has a surface that curves toward at least a portion of the outlets of the first set of microchannels,

and

further comprising a flow path that is adjacent to either the header or the footer, wherein the flow path is separated from the header or the footer by a curved wall that has one surface facing the microchannels and one surface that faces the flow path.

42. The device of claim 41 wherein both the header and the footer have a surface that curves toward the microchannels.

43. The device of claim 39 wherein the device is a component of a larger device.

44. The laminated device of claim 40, wherein the device comprises a vaporizer, wherein the footer comprises a roof, and the roof has at least two sides that converge to form an apex.

45. The device of claim 44 wherein the roof comprises multiple outlets.

46. The device of claim 39 formed by a method comprising stacking shims such that shim thickness is substantially parallel to fluid flow through the device, as flow will occur during normal operation of the device is in operation.

47. Apparatus for vaporizing water comprising:

an inlet leading to a first set of microchannels for a liquid to flow into;

a second set of microchannels for a fluid to flow through;

wherein the first set of microchannels is adjacent to the second set of microchannels; and

wherein the vaporizer possesses a performance characteristic such that, when tested by flowing air at 247 SLPM and 279 °C as a heat transfer fluid and water at 20 mL/min and 280 psig, pressure drop through the device for the partially boiling water increases by less than 5 psig.

48. A laminated device capable of operating with fluids of different pressures, comprising:

at least one microchannel; and

at least one other chamber;

wherein the at least one microchannel is adjacent to the at least one chamber; and wherein the at least microchannel and the at least one chamber are separated by a wall having a thickness of 5 mm or less;

wherein the laminated device is characterized by a pressure resistance such that a first fluid stream 279 C and 8 psig is passed through the at least one microchannel, and a second fluid stream at 210 C and 280 psig is passed through the at least one other chamber for 1000 hours during which there are 10 thermal cycles to ambient temperature of the entire device; and wherein after 1000 hours operation, each fluid flow path is pressurized to 50 psig and held for 2 hours; and wherein the pressure remains substantially constant as measured by a leak rate of less than 10^{-6} standard cubic centimeters per second of helium to the environment; and further wherein the at least one other chamber is pressurized to 50 psig, leaving the at least one microchannel open to atmosphere, and held for 2 hours; and wherein the pressure in the at least one other chamber remains constant as measured by a leak rate of less than 10^{-6} standard cubic centimeters per second of helium indicating minimal internal leak paths.

49. A method of conducting a process with a two phase mixture in a microchannel device, comprising:

passing a fluid into the device of claim 47.

50. A method of vaporizing water comprising the steps of:

passing a liquid into the first set of microchannels in the apparatus of claim 52; and

simultaneously, passing a fluid into the second set of microchannels in the apparatus of claim 52;

wherein the fluid is at a temperature sufficient to vaporize at least a portion of the liquid.

51. The method of claim 50 wherein the liquid and the fluid flow in opposite directions.

52. Apparatus for vaporizing water comprising:

an inlet leading to a first set of microchannels for a liquid to flow into;

a second set of microchannels for a fluid to flow through;

wherein the first set of microchannels is adjacent to the second set of microchannels; and

wherein the vaporizer possesses a performance characteristic such that, when tested with 1.5 ppm TDS water of which the total solids comprises at least 7% Ca, 15% Mg and 2% Si is passed through the first set of microchannels at 280 psig, a 210 °C inlet temperature, and a flowrate of 20 mL/min and a flow air of air at 8 psig, 279 °C and a flowrate of 247 SLPM , over 40% of the water boils with a pressure drop rise of less than 5 psig through the first set of microchannels after 1000 hours of operation.

53. The apparatus of claim 52 wherein the vaporizer possesses a performance characteristic such that, when tested with 1.5 ppm TDS water of which the total solids comprises at least 7% Ca, 15% Mg and 2% Si is passed through the first set of microchannels at 280 psig, a 210 °C inlet temperature, and a flowrate of 20 mL/min and a flow air of air at 8 psig, 279 °C and a flowrate of 247 SLPM , over 40% of the water boils with a pressure drop rise of less than 5 psig through the first set of microchannels after 5000 hours of operation.

54. The vaporizer of claim 52 comprising at least two sets of microchannels for a liquid to flow into;

and further comprising at least two sets of microchannels for a fluid to flow through;

wherein each set of microchannels is arranged in a row; and

wherein the sets of microchannels for a liquid to flow into and the sets of microchannels for a fluid to flow through are arranged in alternating rows.

55. The vaporizer of claim 54 wherein each row comprises at least three microchannels.

56. A laminated device capable of transferring heat to or from a fluid passage within the device, comprising:

a stack of shims that have been bonded together;

wherein the stack of shims comprises a first component having dimensions of height, width and thickness;

wherein at least a portion of the height of the first component is greater than 1 μm, at least a portion of the width of the first component is greater than 1 μm, and at least a portion of the thickness of the first component is greater than 1 μm; wherein height, width and thickness are mutually perpendicular;

wherein the stack of shims comprises a second component having dimensions of height, width and thickness;

wherein at least a portion of the height of the second component is greater than 1 μm, at least a portion of the width of the second component is greater than 1 μm, and at least a portion of the thickness of the second component is greater than 1 μm and wherein at least a portion of at least one of the height, width or thickness of the second component is less than 2 mm; wherein the directions of height, width and thickness are the same directions as the first component;

wherein the stack comprises shims, wherein at least 3 adjacent shims contain at least one aperture within each shim, the apertures being defined by borders within each shim, and the second component is within or is formed by the at least one aperture in each of said at least 3 adjacent shims; and

wherein the second component conforms to the first component in the directions of height, width and thickness.

57. The device of claim 56 wherein a flow path is present in said at least three adjacent shims and wherein a straight, unobstructed line is present through the flow path in said at least three adjacent shims.

58. The device of claim 57 wherein the second component comprises a heat exchanger.

59. The device of claim 58 wherein the first component comprises a reaction chamber.

60. The device of claim 56 wherein the first component and the second component comprise curved surfaces.

61. A method of cooling or heating a component comprising passing a fluid through the second component of the device of claim 58.

62. The device of claim 57 wherein the first component is within or is formed by at least one aperture in each of said at least 3 adjacent shims; wherein the apertures that the first component is within or is formed by are different than the apertures that the second component is within or is formed by.

63. The device of claim 62 wherein the apertures of said at least 3 adjacent shims in which the first component is within or is formed form a flow path, and wherein a straight, unobstructed line is present through that flow path in said at least three adjacent shims.